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Hazard Evaluation for the Mars Pathfinder Prime Landing Site from Synthesis of Radar Ranging and Continuous Wave Observations during the -1995 Mars Opposition

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During the 1995 Mars Opposition, the sub-Earth latitudes available for Earth-based radar observations fortuitously covered a large percentage of the possible landing sites for Mars Pathfinder. The preliminary prime landing site at the mouth of Ares Vallis in southeastern Chryse Planitia in particular was available at closest approach when the radar returns would be strongest. The 100 x 200 km Ares Vallis landing ellipse covers an area that was rejected as a Viking Lander site in 1976 due to Goldstone CW radar echoes" with low signal-to-noise (SNR). The Goldstone radar system at 3.5-cm is now 12 dB more sensitive than the 13-cm system in use at the time of the Viking landing site assessment, and thus definitive results on the potential problems of this site are expected. We will present updated and integrated evaluations for both landing hazards and Rover operation at the Ares Vallis site based on two types of radar observations: radar delay-Doppler profiles (ranging for short) and Continuous Wave (CW) radar spectra obtained using the Goldstone 70-m antenna at X-band (3.5-cm). The "ranging" data are in the form of delay-Doppler profiles which fall along a "great circle" on Mars which are nearly lines of constant latitude. The Doppler frequency resolution provides a longitude resolution of about 4 km, while the delay resolution implies a latitude resolution of about 100 km. Three quantities can be extracted from the multiple views of the pieces of the profiles: topography, reflectivity, and Hagfor's C parameter (a measure of rms slope). For CW observations, echoes are recorded simultaneously in both the same sense of circular polarization as transmitted (the SC sense) and the opposite (OC) sense. The circular polarization ratio thus obtained is a measure of near-surface complexity, or "roughness," at scales near the 3.5-cm observing wavelength.

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